A-50

A Compact-Short Focal Distance Bent Crystal Laue Analyzer for Copper Speciation Studies

Naresh Kujala[1], C. Karanfil[2], T. C. Irving[1], and Raul Barrea[1]

[1]The Biophysics Collaborative Access Team (BioCAT), Dept. of Biological Chemical, and Physical Sciences, Illinois Institute of Technology, Chicago, IL 60616
[2]Physics Department, Faculty of Arts & Sciences, Muðla University, Kötekli-Muðla 48187, Turkey

X-ray fluorescence emission is used for x-ray absorption determinations of diluted biological samples like tissue sections and cultured cells, where metal concentrations are typically a few parts per million. This low metal concentration required a high-flux incident beam capable of generating enough fluorescence x-rays of the element of interest to be detected. The main drawback in this configuration is the high intensity of the scattering signal from the supporting matrix. Measuring copper Kα fluorescence from tissue samples, for instance, can be critically masked by the strong scattering signal, reducing the sensitivity level and potentially saturating conventional solid-state photon-counting detectors. A bent crystal Laue analyzer (BCLA) is a suitable alternative tool to fluorescence x-ray absorption spectroscopy measurements when high rejection of the unwanted scattering signal is required. We have designed a compact-short focal distance log spiral BCLA for Cu Kα fluorescence measurements. A solid aluminum bender provides the proper bending shape for the silicon crystal wafer to preserve the correct angle of incidence between the fluorescence x-rays and the diffraction planes. The BCLA is mounted on an XY motorized linear stage for easy alignment. The size of the vertical beam profile is a critical parameter for the BCLA energy resolution (~18 eV @ Cu Kα line) thus a microbeam of ~5 microns FWHM and intensity of $1.0 \bullet 10^{12}$ photons/sec is used at the 18-ID BioCAT beamline. The scattered (nondiffracted) x-rays travel straight through the crystal and are blocked by molybdenum soller-slits. The diffracted x-rays are detected by a SDD detector and the corresponding Kα peaks are discriminated by preselected single channel analyzer regions of interest. This configuration allows reducing even more of the background signal. The designed BCLA will be used on copper speciation studies in biological samples with specific applications to cancer biology.